NASA TECH BRIEF

Multichannel Pulse Height Analyzer Is Inexpensive,
Features Low Power Requirements
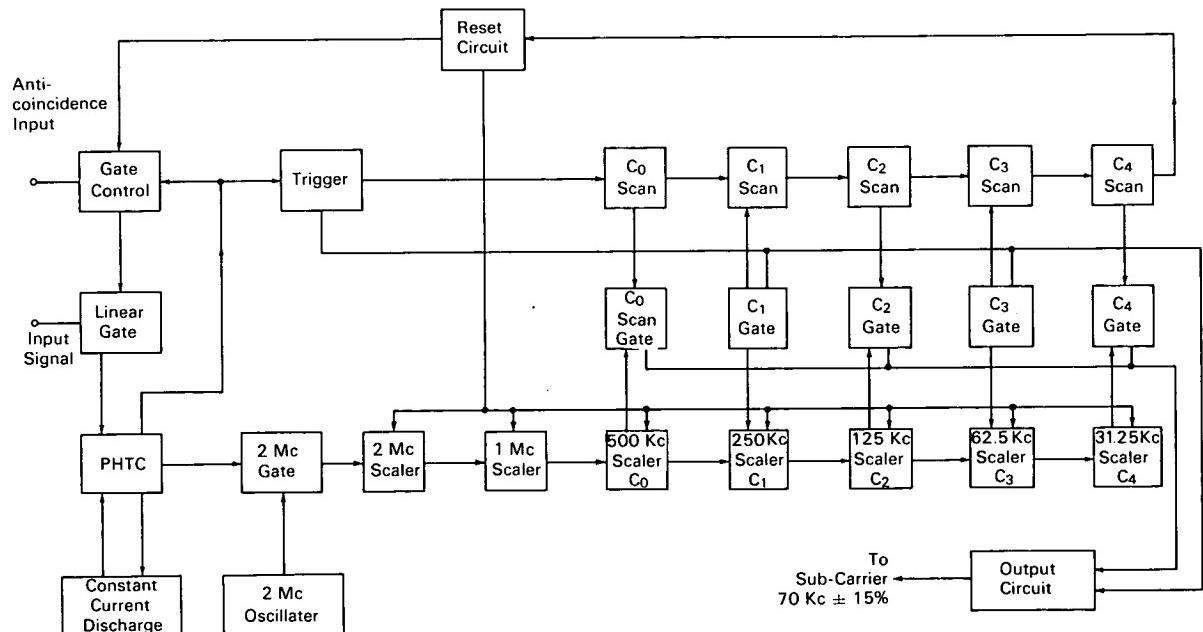
The problem:

To design a simple, low cost, low power consumption multichannel pulse height analyzer for balloon and rocket investigation of solar neutrons with energies greater than 10 Mev. Commercially available analyzers are prohibitive in cost for modest investigation programs, and present volume and weight problems in these applications.

The solution:

A pulse height analyzer flight unit costing approximately $350 (exclusive of labor) and weighing about 4-1/2 pounds. The unit can operate in a temperature range of −30° to +70°C and withstand storage temperatures from −50° to +90°C.

How it's done:

The device is essentially a pulse height-to-series binary converter. The signal input is fed through a linear gate to a pulse height-to-time converter circuit (PHTC) where the pulse height spectrum is converted to a time spectrum by charging a capacitor to the peak voltage of the input pulse, and then linearly discharging the capacitor through a constant current source. The PHTC output is a positive pulse referred to as the "T pulse", whose duration, which is proportional to

(continued overleaf)

the amplitude of the input pulse, gates on a 2 Mc oscillator that in turn feeds a seven-stage cascaded binary counter. The counter register stores a binary number equivalent to the pulse height input. Analysis of the maximum input pulse (3v) requires 64 μsec.

Upon input pulse termination (approximately 1.5μsec) the linear gate is closed for 600μsec by the gate control and a 100μsec trigger pulse is generated. Thus the pulse height-to-time conversion is completed before the trigger pulse terminates, and the "scan" is generated as soon as the trigger pulse is terminated. The "scan" circuits are monostables that sequentially generate 100μsec pulses and search the outputs of the scalers. If a scaler is left in a "one" state, the scan pulse will pass through a diode "and" gate and be fed to the output circuit. The sequential scan circuits are C_0, C_1, C_2, C_3, and C_4. When the C_4 scan pulse is completed, a gate trigger is generated to reopen the linear gate and reset all scalers within 1μsec of linear gate reopening. Since the scalers do not operate until the input pulse terminates (1.5μsec), the system can analyze an input pulse as soon as the linear gate opens. Thus each pulse requires 600μsec to analyze and the average repetition rate capability of the analyzer is 1667 pps.

While the circuit contains 7 scalers, only 5 are used to obtain the binary output. The two additional scalers permit conversion from 32 to 128 channels and lessen ambiguity between adjacent channels. Such ambiguity is inherent when a continuous running oscillator is "gated" on where the gating is not synchronized, and is intolerable when the device is used as a 32-channel pulse height analyzer.
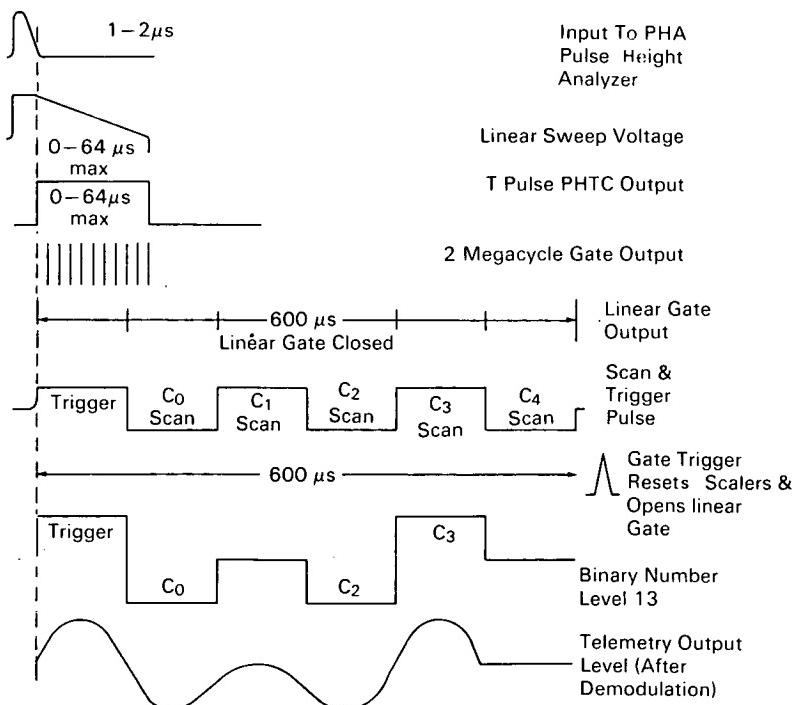
An anticoincidence unit is provided that can be used to gate off unwanted pulses before they reach the PHTC. The anticoincidence pulse would be +5v and precede the input signal by at least 0.25μsec. This input can also be used for upper level discrimination if an additional discriminator is added to the circuitry. When pulse height-to-binary conversion is completed, the information is fed to an FM–FM telemetry system. The telemetered binary number consists of a series of bipolar square waves preceded by a positive trigger pulse as shown in the lower figure. The trigger pulse synchronizes the ground circuits and C_0 through C_4 represent bits 1 through 5, respectively. The bipolar pulses are 100μsec wide so they may be transmitted on a subcarrier with a total bandwidth of 20 kc.

Note:

Inquiries concerning this invention may be directed to:

Technology Utilization Officer
Headquarters
National Aeronautics and Space
Administration
Washington, D.C. 20546
Reference: B67-10258

Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C. 20546.

Source: C. J. Ewald and A. A. Sarkady
of The University of New Hampshire
under contract to
NASA Headquarters
(HQN-10020)